



3700 San Martin Drive
Baltimore, MD 21218
(410) 338-4700

(NASA-CR-197717) IRON K(ALPHA)
LINES FROM BROAD-LINE RADIO
GALAXIES Final Technical Report, 14
Mar. 1994 - 14 Mar. 1995 (Space
Telescope Science Inst.) 1 p

N95-71077

Unclass

April 21, 1995

29/89 0047095

Ms. Gloria R. Blanchard
Grants Officer
NASA Goddard Space Flight Center
Code 286.1
Greenbelt, MD 20771

RE: NAG5-2546, Closeout Documentation

Dear Ms. Blanchard:

Enclosed is the following closeout documentation for the above referenced grant, entitled
"Iron Ka Lines From Broad-Line Radio Galaxies", under the direction of Dr. Mario Livio.

Final Technical Report
~~Final Financial Report~~
~~Final Property/Inventory Report (2)~~
~~Final Patent/Invention Report~~

Should you have any questions or require additional information, please call me at
(410) 338-1534.

Sincerely,

A handwritten signature in cursive script, appearing to read "Evelyn D. Ryans".

Evelyn D. Ryans
Contracts and Grants Coordinator

Enclosures

cc: Dr. Mario Livio
Property Administrator
Dr. Nicholas White, Code 668 - (3)

CASI - (2)
Attn: Accessioning Department
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934

PERFORMANCE AND EVALUATION REPORT

GP-90-10

REPORTING PERIOD: From: 3/14/94 To: 3/14/95☐ Interim Report
☒ Final Report

NAG5-2546

Grant Number

I. PRINCIPAL INVESTIGATOR: Mario Livio

II. INSTITUTION: NASA/Goddard

III. PROJECT TITLE: Iron K α Lines from Broad-Line Radio Galaxies

IV. SUMMARY OF PROJECT ACTIVITIES (please attach a second page if needed):

1. Brief description of the primary objectives and scope of the project:

This project involves a spectroscopic study of the broad-line radio galaxy 3C 390.3 in the X-ray band (0.5 - 10 keV), which takes advantage of the high spectral resolution of the *ASCA* detectors. The primary scientific objective is to detect the Fe K α line and study its profile. The optical spectrum of this object shows double-peaked H α and H β lines, which have traditionally been attributed to emission from an accretion disk. Hence, it is a very strong candidate for displaying a double-peaked Fe K α line. The significance of detecting double-peaked X-ray lines lies in that such a detection would reinforce the idea that double-peaked emission lines observed in AGN spectra originate in an accretion disk, and thus provide the most direct, kinematic evidence for the presence of accretion disks in these objects.

2. Brief description of the findings:

The source was detected by *ASCA* with a mean count rate of 0.5 s^{-1} per SIS and 0.4 s^{-1} per GIS. The continuum spectrum is well described by a powerlaw with a photon index of 1.7, with a 2 - 10 keV flux of $1.7 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$. An emission line is also detected with a rest energy of 6.4 keV, corresponding to K α emission from cold iron. The line has an equivalent width of about 190 eV, and is resolved, with a FWHM of about 16,000 km s $^{-1}$. The profile of the line is consistent with the profiles of the double-peaked Balmer lines, although the signal-to-noise ratio is not high enough to allow detailed model fitting. The measured equivalent width and centroid energy of the line imply an origin in cool, dense material, at a few hundred gravitational radii from the central massive object. An origin in Thompson-thick clouds in the broad-line region is a viable alternative to accretion-disk emission, but an origin in "standard", thin clouds, or in the obscuring torus is disfavored on the basis of the observed properties of the line.

3. Name and date (or anticipated) date of the publication of results:

The analysis and interpretation of the data has been completed and a paper describing the findings in detail has been submitted to the *Astrophysical Journal*. The results were also presented at the AAS meeting in Tucson in January 1995 (BAAS, 26:4, 1283).

4. Suggestions and additional comments:

Signature of Principal Investigator

Date

47095
Mario Livio P-1
4/5/95